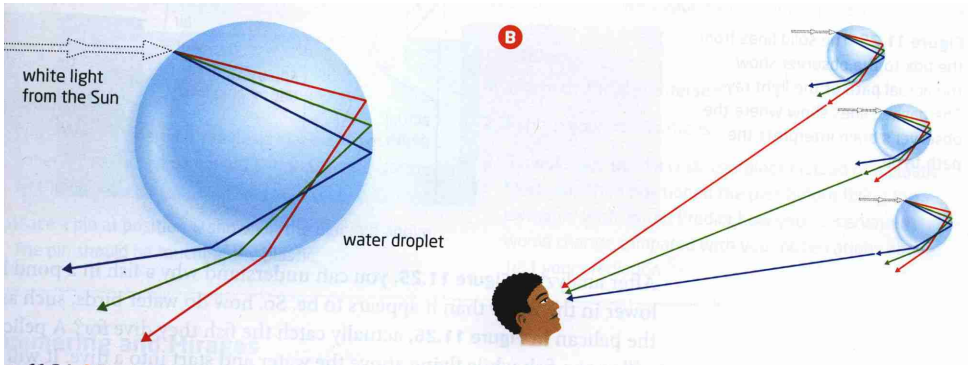
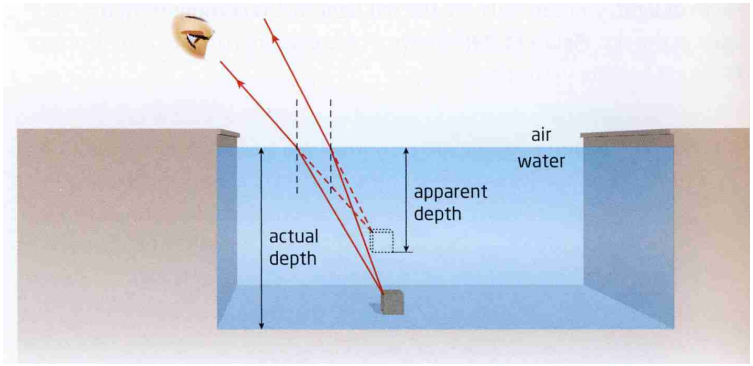
Optical Phenomena in Nature

What is a rainbow and why do they occur?



- **Rainbows** are arcs of colours which represents the visible spectrum of light.
- Rainbows appear opposite the sun after a rainstorm, when the sky is filled with tiny water droplets.
- When light **refracts** into and out of the droplet, each wavelength emerges at a different angle
- Red is directed more downward than other colours, and your eyes see red light from droplets higher in the sky. Blue light is refracted more parallel to the ground, and your eyes see blue lower in the sky.
- Sometimes a **double rainbow** forms. This occurs when sunlight reflects twice inside rain droplets. The second rainbow is not as bright and has a different order of colours than the first rainbow.

Apparent Depth:



- Light from an object placed underwater will refract as travels between water and air.
- We can use a ray diagram to locate the image of the object by tracing the refracted rays backwards until they meet at a point.
- The location of this image is different from the actual location of the object.
- The object is actually deeper than it appears to be. This phenomenon is called **apparent depth**.

Shimmering images and Mirages:

- Sometimes on a really hot day in the summer, the air above the ground will look like it is shimmering.
- The air immediately above the ground is extremely hot while the air higher up is cooler. When light travels through air at different temperatures, it refracts because hot air is less dense than cooler air.
- There is no distinct boundary between regions of air at different temperatures. Therefore the light does not bend like it does when it crosses between two media. Instead the light tends to travel on a curved path.
- As well, the direction and the amount of this bending constantly changes as the air conditions constantly change as well. The end result is that the air looks like it is **shimmering** due to this refraction of light.

- A **mirage** occurs similar to shimmering but on a much larger scale. The most common places that mirages are seen are in deserts or on a hot highway.

- If the weather gets very hot, the sand or the paved surface can become very hot as well. As the air above the ground becomes very hot, light travelling through that region refracts and shimmering occurs.
- Blue light from the sky travels towards the ground but begins to curve as it hits the hotter air. As a result, this light curves towards your eyes and it appears as if the light is coming straight towards you. We naturally assume that light travels in a straight line, so we assume that the light that we see is coming from directly ahead of us.
- This is called a mirage, where an object appears to be on the ground but is not really there. The blue light from the sky that curves towards us makes us believe that there is a shimmering blue object directly ahead of us. We often can misinterpret this is a body of water some distance in front of us.

Usually mirages occur in very hot climates, however it is possible for mirages to occur in very cold climates. This happens when a weather condition called a **temperature inversion** occurs. Sometimes winds bring warm air over a very cold ocean. Light rays from objects on the cold ocean travel upwards. When the light hits the warmer air, it curves back down. As a result, the mirage of the object appears to be floating in the sky. Sometimes the paths of light travelling from the object may become inverted. This causes the object to appear upside down.

Homework

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